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**PORTO RICO AGRICULTURAL EXPERIMENT STATION,  
D. W. MAY, Agronomist in Charge,  
Mayaguez, P. R.**

**CIRCULAR No. 18.**

**Under the supervision of the STATES RELATIONS SERVICE,  
Office of Experiment Stations, U. S. Department of Agriculture.**

**THE SELECTION OF SEED CORN IN  
PORTO RICO.**

**BY**

**H. C. HENRICKSEN, Specialist in Farm Management.**



Issued September 2, 1920.



**WASHINGTON:  
GOVERNMENT PRINTING OFFICE.  
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[Under the supervision of A. C. TRUE, Director of the States Relations Service, United States Department of Agriculture.]

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# THE SELECTION OF SEED CORN IN PORTO RICO.

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## INTRODUCTION.

It has been found from experience gained during visits to farms, farmers' meetings, and fairs, that there is great need in Porto Rico for systematic instruction in the selection of seed. Attempts made to select seed corn, for instance, have not been found at all satisfactory because of a lack of well-defined standards. Though the corn commonly grown on the island is as a whole very good and can be greatly improved by selection, yet an attempt to segregate it into varieties would probably be of little value at this time as it is too mixed.

The purpose of this circular is threefold: (1) To create an interest in corn judging, so that the formation of corn clubs will be the result; (2) to give directions which will serve as a textbook for students in corn-judging classes as well as for use at fairs; and (3) to give a few simple rules for those farmers who are not prepared to use the more elaborate score card.

## OBJECT OF SEED SELECTION.

The general rule that like produces like is, in large measure, applicable to corn. Unfortunately, it is not possible to tell by merely looking at an ear of corn whether the kernels when planted will produce similar ears. It has, however, been amply demonstrated that the judicious selection of corn continued from year to year not only will improve its yield, but will establish more uniform grades; furthermore, such wise selection will serve to stimulate a greater interest in progressive agricultural methods.

From the standpoint of the farmer, the object of seed selection is as the purpose of farming in general; that is, to make money; and, indeed, no operation in connection with farming will give a larger

return for the time expended than that of seed selection. This is especially true in Porto Rico for such crops as corn, in which no varieties have as yet been established. At the present time the real object of seed-corn selection on the island should be to reach a higher standard and greater uniformity in the corn grown, which unquestionably will result in very much larger yields. Those who are sufficiently interested to make this their object will after a few years reap great benefits, as will also specialists in plant breeding who will have plenty of material with which to work for further improvement.

### STRUCTURE OF THE CORN KERNEL.

A kernel that is not too dry can readily be split with a sharp knife. A very dry kernel may be softened by soaking in hot water for a short time, or in cold water overnight. After the kernel is split, as shown in the following illustration (see fig. 1), the structure is readily discernible.

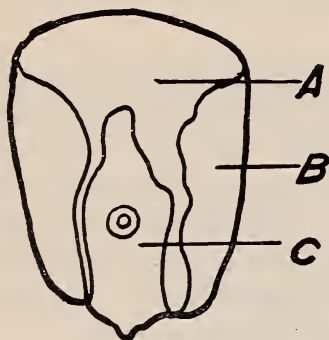


FIG. 1.—Structure of kernel: A, White starch; B, horny starch; C, germ.

A careful study of the illustration and of the descriptive terms used will enable everyone to understand them when referred to in the text. The illustration represents dent corn, the kind commonly grown in Porto Rico. The white starch, which reaches entirely to the surface of the crown, shrinks while the corn is ripening, leaving a dent from which the species derives its name.

The food or feeding value of corn depends upon its structure. The white starchy part contains less protein than the horny starchy part, and is therefore less valuable. The germ, though rich in protein, is chiefly valuable for the oil it contains. Application of this knowledge will make it possible to increase the quality and yield of the corn grown by selecting for kernels with a small starch content and a large germ.<sup>1</sup> That, however, is a point which few planters in Porto Rico are at present ready to take up. Since the price of corn is not determined by quality, farmers are naturally more interested in yield.

### SPECIES OF CORN.

Corn may be grouped into several different species according to the structure of the kernel.<sup>2</sup>

<sup>1</sup> A student may satisfy himself in regard to the content of a kernel by splitting it open and carefully wiping the loose starch from the horny part and the germ. On dipping the halves into a weak solution of iodine, the white starch will take on a deep purple color, whereas the germ will not be affected in the least, while the horny part will be very little affected.

<sup>2</sup> This chapter is based on U. S. Dept. Agr., Office Expt. Stas. Bul. 57 (1899), *Varieties of Corn*, by E. L. Sturtevant.



Popcorn, as distinguished from other sorts, is composed almost entirely of horny substance, the better varieties containing practically no white starch. The popcorn is a small yielder in comparison with field corn and is valuable only because of its popping quality.

Sweet corn, the kernels of which are readily distinguished because of their being more or less wrinkled when ripe, has, like the popcorn, a large amount of horny substance which is translucent in appearance. As yet sweet corn has not been successfully grown in the West Indies.

Starchy sweet corn, the lower part of its kernel being starchy with the upper part horny and translucent, would seem to be adaptable to Porto Rico because of its Mexican or Peruvian origin.

Soft corn is a class of corn containing no horny substance. The kernel consists entirely of white starch and germ. This species being of tropical origin, has probably been grown in Porto Rico from time to time, yet it is now seldom found.

Flint corn, which is characterized by having the white starchy part entirely inclosed in the horny part, is not dented, although at the cap the horny part may be so thin as to dent when the underlying starch shrinks. Undoubtedly flint corn has been grown more or less extensively in Porto Rico, but at present pure flint corn is rather rare. There are a number of types of what would seem to be flint corn; investigation, however, proves most of these to be distinctly dented and white capped, and on splitting them open the white starch at the crown is found to reach entirely to the surface.

Dent corn is distinguished from other species by having a large, white starchy part reaching entirely to the cap, the horny part being confined to the sides of the kernel. The rest of the circular will deal with dent corn only, since it is the kind most commonly grown in Porto Rico.

#### SHAPE OF EAR.

An ear is called cylindrical when it is of nearly equal diameter throughout. The shape of an ear is ideal the more nearly it is cylindrical, and more undesirable as it approaches the tapering style. On the tapering ear many of the kernels are so small and odd-shaped that the yield of grain is greatly diminished. For practical purposes an ear may be described as cylindrical, nearly cylindrical, tapering, and very tapering. The cylindrical ear is not typical of the corn grown in Porto Rico, the more desirable types being usually about an inch less in diameter at the tip than at the butt. (See figs. 2 and 3.)

#### SIZE OF KERNEL.

The weight of the grain on an ear is to a large extent dependent upon the depth of the kernels. Other conditions being equal, an ear with kernels eight-sixteenths inch deep will yield considerably more

grain than one on which the kernels are but seven-sixteenths inch deep. The depth of the kernel is therefore one of the most important variety characters; and it is moreover more liable to be inherited than many of the other characters by which corn is judged. For this reason it is important to measure the kernels carefully, according to the directions given in the section headed Explanation of Score Card No. 1. In the Porto Rican grown corn, a depth of seven-sixteenths inch with a breadth of six-sixteenths inch is a very common size of grain. The depth is usually very uniform, that is, most of the ker-

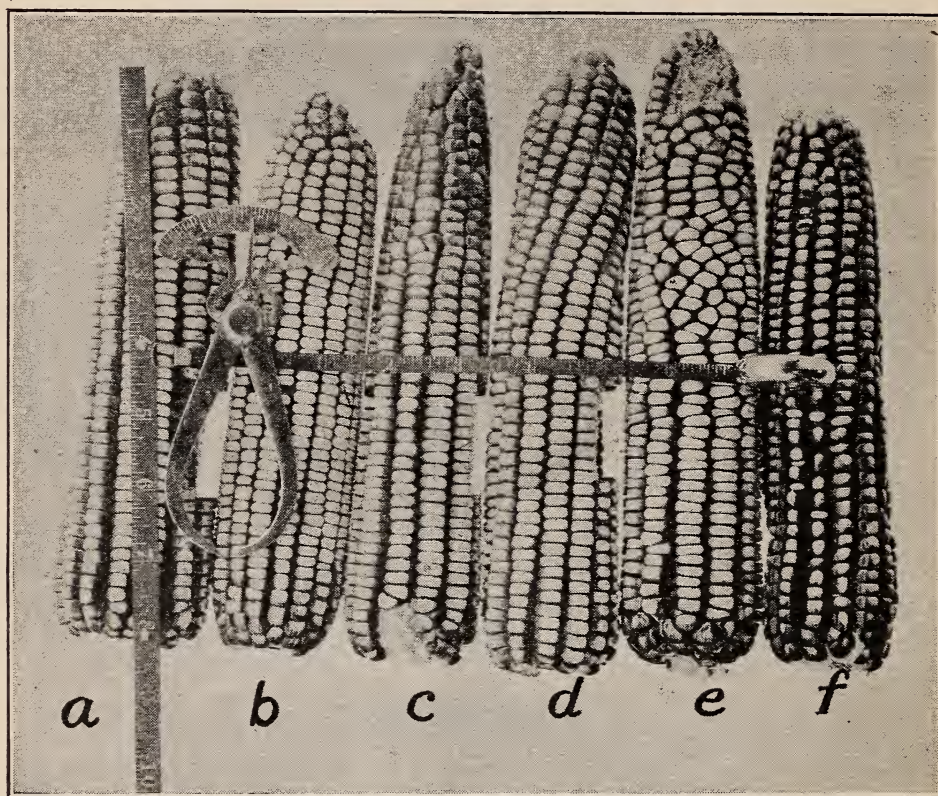


FIG. 2.—Shape of ears: *a*, Nearly cylindrical, groove between rows very wide; *b*, cylindrical, groove narrow; *c*, very pointed; *d*, rows crooked; *e*, kernels disarranged; *f*, kernels uneven in size and shape. Ruler, tapeline, and compass for measuring ears.

nels from the middle of an ear will measure the same. The breadth is more variable and of less importance as a means of identification.

#### SHAPE OF KERNEL.

The following shapes are represented in Porto Rican grown corn:

*Rectangular*.—The kernel is nearly as broad at the base as at the crown, the sides are straight, and the kernels fill up the entire space on the cob.

*Wedge-shaped*.—The kernel is more or less pointed, being considerably broader at the crown than at the base, but with straight sides.



Therefore, when such kernels are placed close together on the cob, the furrows between the rows will be wide and the yield of grain will be smaller than where the kernels are more nearly rectangular.

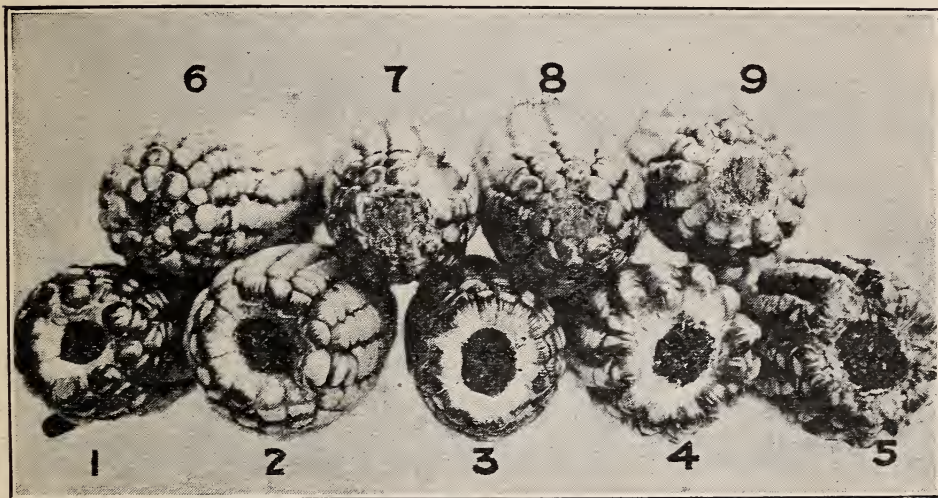


FIG. 3.—Shape of butts and tips. Note the well-shaped butts in 1, 2, and 3, and the large open butts in 4 and 5. A tip as well filled as is usually found in Porto Rican grown corn is shown in 6. More undesirable tips are shown in 7, 8, and 9.

*Peg-shaped.*—A kernel that is narrow throughout and very pointed, having straight sides, is described as peg-shaped. This shape is undesirable for the reason that it results in poor yield.

*Rounded, deeper than broad.*—A kernel with rounded sides, being deeper than broad. Such a shape is not so desirable as the rectangular, as the kernels do not fill up the space so completely because of the rounded sides.

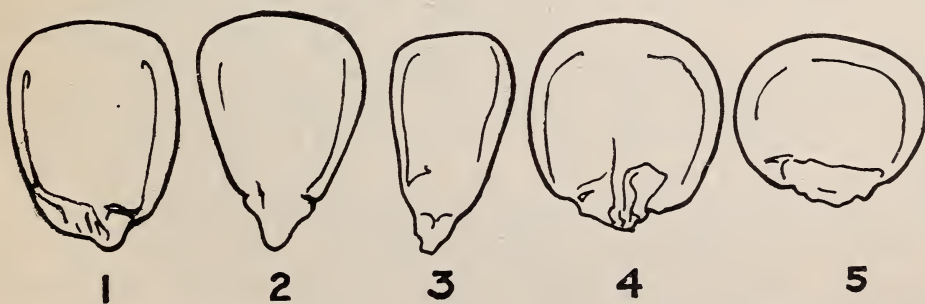


FIG. 4.—Shape of kernel: 1, Rectangular; 2, wedge-shaped; 3, peg-shaped; 4, rounded, deeper than broad; 5, rounded, broader than deep.

*Rounded, broader than deep.*—A kernel that is broader than deep will usually yield less than one of the reverse shape. If, in addition, such a kernel has rounded sides, it is doubly undesirable. (See fig. 4.)

## COLOR OF KERNEL.

When considering color in connection with corn it should be thoroughly understood that no one color is superior to any other, yet color is a variety character and can therefore be used like size, shape, or any other character, for separating one variety from another. While a great many colors are apparently represented in Porto Rican grown corn, in reality there are usually only three—white, yellow, and red. (Fig. 5.)

The white is frequently horny white, seldom pure white, like the inside starchy part of the kernel, but regardless of the exact tint it can not be mistaken, as any slight tinge of yellow or red is readily discernible.

Yellow is found in a great many shades from pale lemon to very deep orange. The pale shades cause no difficulty, for, regardless of how pale they are, the least yellow tinge in a corn puts it in the class with the yellow. The darker shades offer more difficulty because



FIG. 5.—Color of corn: 1, Horny white with white cap; 2, yellow with white cap; 3, light red with white cap; 4, red streaked without white cap; 5, dark red without white cap.

they resemble the light reds. After a little practice, however, it is not difficult to determine whether or not a color has red in its make-up. Most of the yellow corn found in Porto Rico is white capped.

The red corn, or the kernels having a reddish tinge, can always be separated into two distinct types, lighter red with a white cap, and the dark red without the white cap. The different shades of light red may or may not breed pure. If the kernel is of a uniform reddish tinge throughout with a white cap, the corn may be pure, but when red appears in spots or in streaks the corn should be rejected for seed, as this is an indication of cross-pollination. The dark red corn without a white cap is distinct from the former type, and should never be planted close to corn of another color.

This classification is not too difficult for anyone to learn, and a much greater uniformity will result in a few years if care is taken to avoid mixing the four color types here given. The corn of to-day is of course much mixed, and no one need be discouraged if on planting a medium yellow, for instance, he finds at harvest time some white,



a dozen shades of yellow, and perhaps some shades of red. A continuous selection of a certain shade of yellow will in time result in nearly all the ears being of that shade. In order to keep the color continuously the same, it is well to save a few kernels representing the shade selected, keeping them in a well-corked dark bottle, and using them as standards for future selections.

Occasionally black, or bluish black, corn is found. This, like red, is a distinct color in corn and should, if selected, be kept apart from corn of other colors.

### HOW TO SELECT DESIRABLE EARS.

There are two distinct steps in corn selection. One is to select the most desirable ears, using neither measurement nor score card. The other is to take the ears first selected and judge each one very carefully, noting on a previously prepared score card the value of each character. The first step, which consists simply in picking out the most desirable ears from the crop after it is harvested, does not require much time, but it is one which no farmer can afford to neglect. At the same time these questions should be kept in mind: Will it germinate? Is it pure—that is, will the kernels when planted produce ears of the same size, shape, color, etc.? Is the shape desirable? How much will it yield? The following directions will be helpful in determining the approximate value of an ear by looking at it:

Will it germinate? If in doubt, test it. (See germination tester.)  
Look for—

*Moldiness.*—Discard all ears that are the least bit moldy, or that look as if they will not dry out without becoming moldy.

*Ripeness.*—Discard all ears on which the kernels are very wrinkled, dull in color, or discolored.

*Insect injury.*—The principal dangerous insect is the weevil. A few weevil burrows may not cause much damage, but if corn is much weevil-eaten, the germination will be impaired.

Is it pure? Look for—

*Uniformity of kernels.*—Discard all ears having kernels of different color; also all ears having many small or undeveloped kernels, or, in general, kernels of different size.

*Color of cob.*—The cob should be of the same color as the grain, unless difference in color is known to be a variety character.

Is the shape desirable? Look for—

*Straightness of rows.*—Discard all ears on which many of the kernels are irregularly arranged; also ears on which the rows are very crooked.

*Butt.*—The butt should preferably be covered with kernels to the extent that a cavity is left after the ear is broken off the



stalk. The kernels should retain their size and shape well toward the butt.

*Tip.*—The tip should preferably be entirely covered with kernels. The circumference of a short ear, measured 1 to 2 inches from the butt and 1 inch from the tip, should not differ more than  $1\frac{1}{2}$  inches between the points measured. The pointed ear has too many irregular-shaped kernels at the tip resulting in low yields.

How much will it yield? Look for—

*Length of ear.*—Discard all ears less than 7 inches long. If there are enough desirable ears over 8 inches, discard all the shorter ones.

*Circumference of ear.*—An ear 7 to  $7\frac{1}{2}$  inches long should be at least  $6\frac{1}{4}$  inches in circumference but not more than 7 inches. An ear 8 to 9 inches long should be at least  $6\frac{1}{2}$  inches in circumference, and a length of 9 inches and up calls for a circumference of 7 inches and up.

*Depth, shape, and space of kernels.*—Deep rectangular kernels placed so close together that they can not readily be moved by passing the fingers over them, are sure signs of high yield.

*Weight of grain.*—Fifty average well-shaped kernels will weigh about 1 ounce. An ear containing 14 rows with 40 well-shaped kernels in each row will have 560 kernels. This would be at least 11 ounces of grain for planting. The irregular-shaped kernels at butt and tip should not be planted.

#### HOW TO JUDGE SEED CORN.

After a number of apparently desirable ears have been chosen, they should be assorted and further selected. For this purpose procure a long table or several long boards placed at the height of a table. Arrange the ears side by side on the table and have at hand a ruler and tapeline for measuring to one-sixteenth inch, if possible, a pair of scales weighing to one-half ounce, and a pair of self-registering calipers measuring up to 2 inches. The calipers can be bought in San Juan for 60 cents, and everyone should have scales.

When judging corn the first year—that is, when selecting mother ears—use score card No. 1. Later, use score card No. 2. The reason for this will become apparent with increasing familiarity with the subject. First, make a copy of score card No. 1, then number each ear with a small square of paper fastened to the butt with a pin. These preparations will show the necessity of careful work when selecting the ears. To judge as many as 25 ears and fill out the score card is as much as anyone will care to do at one time. The average farmer will do no more than select the ears, but the student, the judge at a fair, or the man who wants to specialize in seed corn, can afford to do no less than that which is called for by the score card.

## Score Card No. 1.

LOCALITY WHERE GROWN..... DATE.....

| Number of ear. | Type.         |                         |               |                  |                   |                   | Germination,<br>20 points. |           |                | Ear characters, 55 points. |                          |               |                  |                          |                          |                  |                 | Kernel characters,<br>25 points. |                   |                   | Total. | Weight of grain (ounces). | Germination test. |
|----------------|---------------|-------------------------|---------------|------------------|-------------------|-------------------|----------------------------|-----------|----------------|----------------------------|--------------------------|---------------|------------------|--------------------------|--------------------------|------------------|-----------------|----------------------------------|-------------------|-------------------|--------|---------------------------|-------------------|
|                | Shape of ear. | Arrangement of<br>rows. | Color of cob. | Size of kernels. | Shape of kernels. | Color of kernels. | Moldiness.                 | Ripeness. | Insect injury. | Length of ear.             | Circumference of<br>ear. | Shape of ear. | Diameter of cob. | Spacing of ker-<br>nels. | Straightness of<br>rows. | Filling of butt. | Filling of tip. | Size of kernels.                 | Shape of kernels. | Color of kernels. |        |                           |                   |
|                |               |                         |               |                  |                   |                   |                            |           |                |                            |                          |               |                  |                          |                          |                  |                 |                                  |                   |                   |        |                           |                   |
| 1.....         | N.C.          | S.                      | White.        | 8×6½             | R.                | Y.                | 10                         | 5         | 5              | 2                          | 3                        | 4             | 3                | 5                        | 2                        | 5                | 3               | 8                                | 6                 | 4                 | 65     | 8.7                       | 100               |
| 2.....         | N.C.          | P.                      | Red.          | 8×6              | R.                | (Red.....)        | 10                         | 5         | 4              | 3                          | 5                        | 4             | 2                | 2                        | 3                        | 3                | 3               | 7                                | 4                 | 5                 | 60     | 8.79                      | 100               |
| 3.....         | N.C.          | P.                      | White.        | 8×6              | W.                | (Mixed..)         | 10                         | 5         | 5              | 5                          | 4                        | 3             | 3                | 2                        | 4                        | 4                | 4               | 8                                | 5                 | 5                 | 68     | 10.38                     | 100               |
| 4.....         | N.C.          | S.                      | Red.          | 7×7              | W.                | Y.                | 10                         | 5         | 5              | 9                          | 3                        | 3             | 2                | 5                        | 5                        | 4                | 5               | 8                                | 8                 | 2                 | 74     | 9.94                      | 100               |
| 5.....         | N.C.          | P.                      | White.        | 7×6              | R.D.              | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 5                 | 68     | 10.38                     | 100               |
| 6.....         | N.C.          | P.                      | Red.          | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 2                 | 74     | 9.94                      | 100               |
| 7.....         | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 5                 | 68     | 10.38                     | 100               |
| 8.....         | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 2                 | 74     | 9.94                      | 100               |
| 9.....         | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 5                 | 68     | 10.38                     | 100               |
| 10.....        | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 2                 | 74     | 9.94                      | 100               |
| 11.....        | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 5                 | 68     | 10.38                     | 100               |
| 12.....        | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 2                 | 74     | 9.94                      | 100               |
| 13.....        | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 5                 | 68     | 10.38                     | 100               |
| 14.....        | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 2                 | 74     | 9.94                      | 100               |
| 15.....        | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 5                 | 68     | 10.38                     | 100               |
| 16.....        | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 2                 | 74     | 9.94                      | 100               |
| 17.....        | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 5                 | 68     | 10.38                     | 100               |
| 18.....        | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 2                 | 74     | 9.94                      | 100               |
| 19.....        | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 5                 | 68     | 10.38                     | 100               |
| 20.....        | N.C.          | P.                      | White.        | 7×6              | R.                | Y.                | 10                         | 5         | 5              | 5                          | 4                        | 4             | 3                | 2                        | 4                        | 4                | 4               | 5                                | 5                 | 2                 | 74     | 9.94                      | 100               |

## EXPLANATION OF SCORE CARD NO. 1.

Corn judging is in large measure based upon comparison and, for that reason, it is always best to judge a set of ears one after another for any one character. Let column 1 be filled in on the score card before starting on column 2; then all of the 20 ears can be judged for arrangement of rows (column 2) before starting on color of cob (column 3), etc.

On the score card sample ears Nos. 9 to 15 are entered to show the method of procedure. The figures at the top of the column from column 7 to 20 are score points grouped under three headings, germination, ear characters, and kernel characters. The germination is dependent upon the soundness of the kernels; that is, ripeness and freedom from moldiness and insect injury, all three together counting 20 points. The ear characters count 55 points, and the kernel characters 25 points.

*Column 1, shape of ear.*—Note whether the ear is nearly cylindrical, pointed, or very pointed.

*Column 2, arrangement of rows.*—In some types of corn the rows are paired; that is, the kernels in two adjacent rows are placed side by side, whereas they are uneven with the kernels in the rows on either side. In other types the kernels are in single rows; that is, they are uneven with those in the adjacent rows. The rows are paired on most of the corn grown in Porto Rico.

*Column 3, color of cob.*—Yellow kernels sometimes grow on a red cob, though usually the cob is of the same color as the kernels. The presence of a cob having a color different from that of the kernels very often indicates impurity, and an ear with this character should be discarded unless it is known to breed true. On the score card ear No. 13 was found to have a red cob and for that reason was discarded.

*Column 4, size of kernels.*—On a piece of cardboard draw with a hard sharp pencil two lines perpendicular to each other, and at the point where they cross measure off ten-sixteenths of an inch to the left on the horizontal line and ten-sixteenths to twelve-sixteenths downward on the vertical line, marking off with a pencil point each one-sixteenth inch and drawing lines through the last five or six marks. Then with a sharp knife cut out a square as shown in figure 6. On another piece of cardboard draw two parallel lines about an inch apart and two other parallel lines crossing the first pair at right angles. With a sharp knife cut along these lines, leaving a cross with arms about an inch wide.

Kernels can be measured with this device to one thirty-second of an inch. Cut the tip off the kernel even with the body, using a sharp knife for this purpose; place the kernel in the square cavity of the cardboard and put the cross firmly against it, pressing it into the



upper left-hand corner. The last figure that is visible above the arm of the cross on the left shows the length of the kernel, the last visible figure along the upper arm giving the breadth. Measure a half dozen kernels; the breadth may vary but the length is usually uniform. (Fig. 6.)

*Column 5, shape of kernels.*—Compare the kernels with those described in the paragraph entitled Shape of Kernel. Note down R for rectangular, W for wedge-shaped, P for peg-shaped, RD for round deeper than broad, and RB for round broader than deep.

*Column 6, color of kernels.*—See section on Color of Kernel (p. 8). Note W for white, Y for yellow, R for red, and DR for dark red.

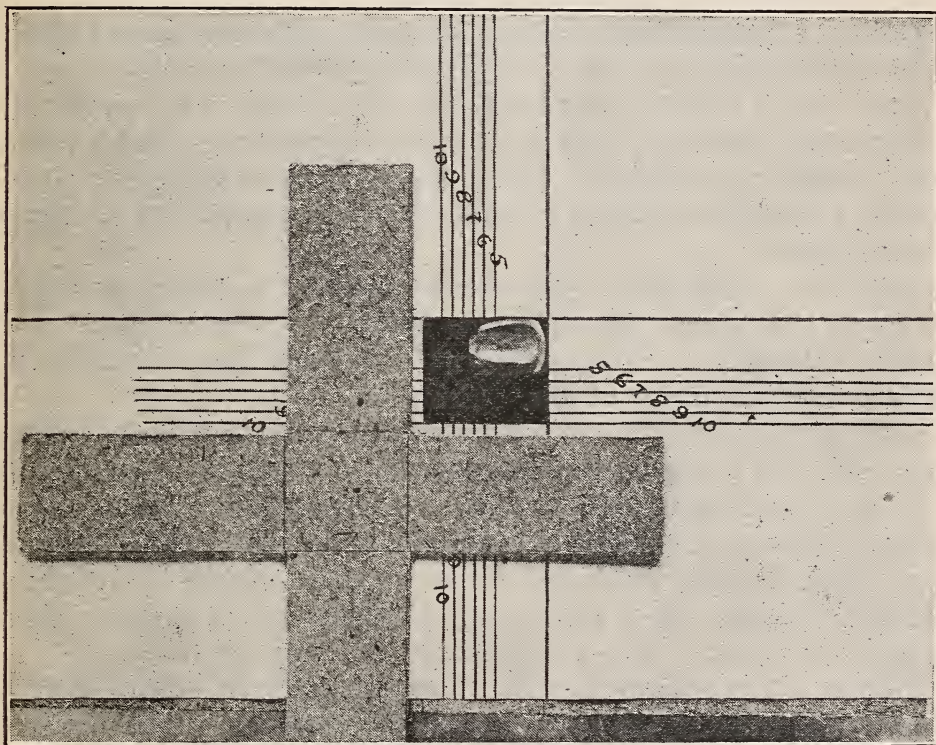


FIG. 6.—Measuring device.

Discard all ears having the least trace of more than one color (see score card, ears Nos. 10 and 12).

*Column 7, moldiness.*—Examine very carefully for moldiness. An ear that is absolutely free from moldiness should receive full 10 points. If many kernels are moldy, the ear should receive but very few points. If, however, there is the least doubt about the majority of the kernels germinating, the ear should be discarded or tested for germination. (See last column.)

*Column 8, ripeness.*—An ear having many very wrinkled or discolored kernels should be tested for germination, but is not to receive any points in this column.

*Column 9, insect injury.*—Look for weevils. The indication that weevils are present is an important factor in this column, though a few weevil burrows may cause no damage. Let the ear be either tested for germination or discarded altogether when much weevil eaten.

*Column 10, length of ear.*—A blunt ear, well filled at the top, should be measured from end to end. On a sharp-pointed ear only that part which is covered with kernels should be measured. A 7-inch ear is entitled to 1 point only;  $7\frac{1}{4}$ , 2 points;  $7\frac{1}{2}$ , 3 points, etc., that is, 1 point for every one-fourth inch above 7 up to  $11\frac{3}{4}$  inches. Nothing longer than  $11\frac{3}{4}$  inches will be found at present except in the very slim flint-like types and seldom in these.

*Column 11, circumference of ear.*—Measure with the tapeline about the middle of the ear. The circumference should be not less than  $6\frac{1}{4}$  nor more than 7 inches on a length of 7 to 8 inches. An ear of this length would receive 2 points for  $6\frac{1}{4}$  inches circumference and 5 points for 7 inches circumference. Ears 8 inches or more in length should receive 1 point for  $6\frac{1}{4}$  inches circumference and 5 points for  $7\frac{1}{4}$  inches circumference.

*Column 12, shape of ear.*—The shape was noted in column 1, though no credit was given. Award points from 1 to 5 according to how desirable the shape is when compared with those types described in the paragraph on Shape of Ear. (See p. 5.)

*Column 13, diameter of cob.*—Remove two to three kernels from as many adjacent rows and from opposite sides of the ear at about the middle. Insert the legs of the calipers in kernel cavities on opposite sides of the ear and read off in sixteenths of an inch. On a separate paper note the size which will be required in column 22. Award points as follows:  $\frac{14}{16}$ , 5 points;  $\frac{15}{16}$ , 4 points;  $\frac{16}{16}$ , 3 points;  $\frac{17}{16}$ , 2 points;  $\frac{18}{16}$ , 1 point. Give credit neither above  $\frac{18}{16}$  nor below  $\frac{14}{16}$ .

*Column 14, spacing of kernels.*—Two factors must be considered, the distance between the rows and the distance between the kernels in the row. An ear on which the kernels are wedged closely together is entitled to 5 points. Credit should be correspondingly less when the kernels are very loose or when the groove between the rows is very large.

*Column 15, straightness of rows.*—In this respect the ideal ear is one which has the kernels so arranged in rows that the rows shall run straight from butt to tip. Ears having a few kernels irregularly placed or having rows winding more or less around the cob should be correspondingly graded.

*Column 16, filling of butt.*—Consider the shape of the butt, the space left uncovered, and the number of odd-shaped kernels. The ideal shape has kernels covering the butt, leaving only a small cavity after



breaking the stalk. Such a butt is generally very regular with a minimum of odd-shaped kernels, in which case the ear is entitled to the full 5 points. A broad flat butt with many odd-shaped kernels more or less irregularly arranged should receive correspondingly less credit.

*Column 17, filling of tip.*—Consider the number of odd-shaped kernels and the space left uncovered. An ideal tip is completely covered with kernels, but the shape of the ear determines the number of odd-shaped kernels found thereon. A cylindrical ear may have large regular kernels closely approaching its tip, whereas a very pointed ear always will have a large number of small rounded kernels. The tips are usually sparsely covered in shapes which approach the ideal found among the corn grown in Porto Rico. For this reason very few ears found at present are entitled to the full 5 points.

*Column 18, size of kernels.*—While the actual size was noted in column 4, no credit was given. Depth of kernel and uniformity of size are important factors and points should be awarded as follows: Depth of kernel  $6\frac{1}{2}/16$ , 1 point;  $7/16$ , 2 points;  $7\frac{1}{2}/16$ , 3 points;  $8/16$ , 4 points;  $8\frac{1}{2}/16$ , 5 points. The other 5 points should be awarded for uniformity which depends on the exactness with which the majority of the kernels conform to these measurements.

*Column 19, shape of kernels.*—In column 5 the shape was noted, but no credit was given. Award 5 points for shape and 5 for uniformity of shape, as follows: Rectangular, 4 to 5 points; wedge-shape, 1 to 3 points. The round deeper than broad may be scored like the wedge-shape. The peg-shape and the round broader than deep are undesirable. Award points for uniformity of shape according to how nearly the majority of the kernels conform to the shape noted in column 5, excluding, of course, the butt and tip kernels.

*Column 20, color of kernels.*—Since not any one color is more desirable than another, let points be awarded according to nearness with which the color of all the kernels conform to that given in column 6.

*Column 21, total.*—Add the figures in column 7 to 20 and enter in this column.

*Column 22, weight of grain.*—As accurately as possible weigh the ear on a pair of scales, entering the weight on a separate paper. The length of the ear measured in connection with column 10 and the diameter of the cob measured in connection with column 13 should be looked up in their respective places. The cubic content of the cob will be found from the table given below. In case of an ear of corn 9 inches in length, place a ruler across the table below the figure 9 appearing in the left-hand column. Suppose the diameter to be 1 inch. Look for  $16/16$  in the upper column and follow down that

column until the ruler is met. The test will show figure 7.07 to be the cubic content.

*Cubic content of cob.*

| Length of cob, inches. | Diameter of cob, inches. |       |       |       |       |       |       |       |       |       |       |
|------------------------|--------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                        | 12/16                    | 13/16 | 14/16 | 15/16 | 16/16 | 17/16 | 18/16 | 19/16 | 20/16 | 21/16 | 22/16 |
| 7.....                 | 3.09                     | 3.63  | 4.21  | 4.83  | 5.5   | 6.2   | 6.97  | 7.74  | 8.59  | 9.47  | 10.39 |
| 7 $\frac{1}{4}$ .....  | 3.2                      | 3.76  | 4.36  | 5.0   | 5.69  | 6.42  | 7.22  | 8.02  | 8.9   | 9.8   | 10.76 |
| 7 $\frac{1}{2}$ .....  | 3.31                     | 3.89  | 4.51  | 5.18  | 5.89  | 6.64  | 7.46  | 8.29  | 9.21  | 10.15 | 11.13 |
| 7 $\frac{3}{4}$ .....  | 3.42                     | 4.01  | 4.66  | 5.35  | 6.08  | 6.86  | 7.71  | 8.57  | 9.52  | 10.48 | 11.5  |
| 8.....                 | 3.53                     | 4.14  | 4.81  | 5.52  | 6.28  | 7.08  | 7.96  | 8.85  | 9.82  | 10.82 | 11.88 |
| 8 $\frac{1}{4}$ .....  | 3.64                     | 4.27  | 4.96  | 5.69  | 6.48  | 7.3   | 8.21  | 9.12  | 10.13 | 11.16 | 12.25 |
| 8 $\frac{1}{2}$ .....  | 3.75                     | 4.4   | 5.11  | 5.86  | 6.67  | 7.52  | 8.46  | 9.4   | 10.44 | 11.5  | 12.62 |
| 8 $\frac{3}{4}$ .....  | 3.86                     | 4.53  | 5.26  | 6.04  | 6.87  | 7.75  | 8.71  | 9.68  | 10.74 | 11.83 | 12.99 |
| 9.....                 | 3.97                     | 4.66  | 5.41  | 6.21  | 7.07  | 7.97  | 8.96  | 9.95  | 11.05 | 12.17 | 13.36 |
| 9 $\frac{1}{4}$ .....  | 4.08                     | 4.79  | 5.56  | 6.38  | 7.26  | 8.19  | 9.2   | 10.23 | 11.36 | 12.51 | 13.73 |
| 9 $\frac{1}{2}$ .....  | 4.19                     | 4.92  | 5.71  | 6.55  | 7.46  | 8.41  | 9.46  | 10.50 | 11.67 | 12.85 | 14.1  |
| 9 $\frac{3}{4}$ .....  | 4.3                      | 5.05  | 5.86  | 6.73  | 7.65  | 8.63  | 9.7   | 10.8  | 11.98 | 13.19 | 14.47 |
| 10.....                | 4.41                     | 5.18  | 6.01  | 6.9   | 7.85  | 8.85  | 9.95  | 11.06 | 12.28 | 13.53 | 14.85 |
| 10 $\frac{1}{4}$ ..... | 4.52                     | 5.31  | 6.16  | 7.07  | 8.04  | 9.07  | 10.2  | 11.34 | 12.6  | 13.86 | 15.22 |
| 10 $\frac{1}{2}$ ..... | 4.64                     | 5.44  | 6.31  | 7.24  | 8.24  | 9.3   | 10.45 | 11.62 | 12.9  | 14.2  | 15.59 |
| 10 $\frac{3}{4}$ ..... | 4.75                     | 5.57  | 6.46  | 7.42  | 8.44  | 9.52  | 10.7  | 11.9  | 13.2  | 14.54 | 15.96 |
| 11.....                | 4.86                     | 5.70  | 6.61  | 7.59  | 8.64  | 9.74  | 10.95 | 12.18 | 13.5  | 14.88 | 16.33 |
| 11 $\frac{1}{4}$ ..... | 4.97                     | 5.83  | 6.77  | 7.77  | 8.83  | 9.96  | 11.2  | 12.44 | 13.8  | 15.22 | 16.7  |
| 11 $\frac{1}{2}$ ..... | 5.08                     | 5.96  | 6.91  | 7.93  | 9.03  | 10.18 | 11.45 | 12.72 | 14.12 | 15.55 | 17.08 |
| 11 $\frac{3}{4}$ ..... | 5.19                     | 6.09  | 7.06  | 8.11  | 9.23  | 10.4  | 11.7  | 13.   | 14.43 | 15.89 | 17.45 |
| 12.....                | 5.3                      | 6.22  | 7.21  | 8.28  | 9.42  | 10.62 | 11.95 | 13.27 | 14.74 | 16.23 | 17.82 |

The average weight of a dry cob is 0.22 to 0.25 ounce per cubic inch. The cob of half dry corn—that is, ripe corn which has been cut about 6 weeks—will probably weigh 0.3 ounce per cubic inch. Ripe corn, which has been cut but 2 weeks or so, will have a cob weighing about 0.35 per cubic inch.

Multiply the cubic content by 0.23 if the corn is perfectly dry. For example, the figure appearing in former paragraph  $7.07 \times 0.23 = 1.62$  ounces. By deducting this figure from the weight of the ear one can obtain the weight of grain which the ear contains.

To prove the calculations, weigh 10 average ears of a lot of corn, shell them, and weigh the cobs and the grain separately. Find the cubic content of each cob according to the table and add the figures. Then the total weight of the cobs divided by the total cubic content gives the average weight per cubic inch. Example: Total weight of cobs, 17 ounces. Total content, 56.5 cubic inches.  $17 \div 56.5 = 0.3$ . For this lot of corn the approximate weight of the cobs may be had by multiplying the cubic contents taken from the table by 0.3.

In measuring the diameter of the cob the legs of the calipers should rest in the cavities from where the kernels were removed and not in the spaces between the kernels. Care should be taken to avoid letting the points of the calipers press in any deeper than the seat of the kernels, and every precaution should be used in taking measurement as the slight difference of one-sixteenth inch in diameter may cause a difference of one-third ounce in the weight of the cob.

*Column 23, germination test.*—Corn that is well ripened, thoroughly dried, and kept secure from insects will be almost sure to germinate.



If there is any question about its germinating quality, the corn should be tested. To test corn, take a box 12 by 18 inches, with a depth of 2 inches, or a smaller size, if desired, may be used (see fig. 7). Cut two pieces of heavy cloth to fit inside the box (a part of an old garment or a heavy sack will serve the purpose). Also a piece of muslin will be needed to fit inside the box. Rule the muslin with a soft pencil or indelible ink in squares or rectangles about 1 by 2 inches. One piece of heavy cloth should be placed in the bottom of the box and the muslin ruled side up on top of that. Soak these cloths with water and make them perfectly smooth. From each ear to be tested 5 kernels are to be taken and placed on the ruled cloth, care being taken to place each set of kernels from the different ears in a square by itself. Number the ears and the squares correspondingly. To protect the germinating kernels from rats, mice, and roaches, it is advisable to place on top of the kernels the other piece of cloth, well

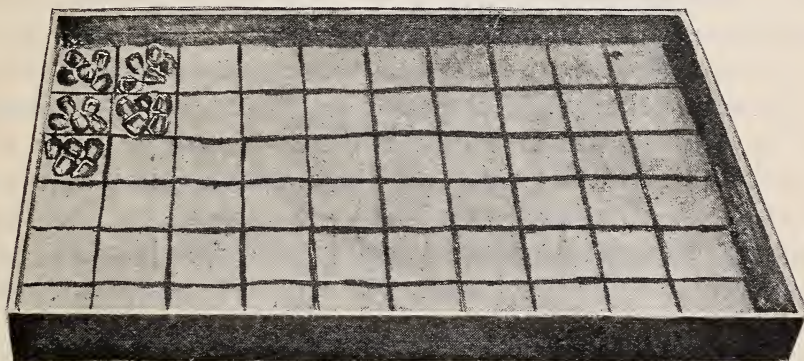


FIG. 7.—Germination box.

moistened, with a close-fitting board on top of that. After three or four days, carefully remove the board and the upper cloth. Count the kernels that have germinated in each square, noting the percentage in column 23. One germinated kernel is equal to 20 per cent, 2 kernels 40 per cent, etc., and 5 kernels 100 per cent.

#### HOW TO INTERPRET SCORE CARD NO. 1.

The ears recorded on the score card may be called mother ears, any one of which, when planted separately from other ears, may become the mother of a famous variety. The questions which now naturally arise are: (1) If any one of these ears is desirable enough to serve as a mother ear, which is the one? (2) Is there sufficient uniformity among certain ears to permit of their being planted together? (3) When there are desirable ears representing different types, is it advisable to plant more than one type?

It is well to remember when considering these questions that only the most desirable specimens were recorded on the score card at the time these ears were first selected. Moreover, none of those recorded

in columns 7 to 23 could be absolutely undesirable, since the ears were subjected to a rigid purity test when columns 1 to 6 were judged. It is possible, however, that the lot of corn under consideration may be very much inferior to some other lot of corn. That is to say, the best ears recorded on the score card may prove inferior when compared with the best ears produced in some other locality. A safe rule to follow is to plant only the best corn obtainable of locally grown seed. If better seed can be obtained from some locality other than the one in which the planting is to be done, it may be desirable to use that seed. In the States, however, it is a well-known fact that seed corn brought from any distance is liable to give a smaller yield than locally grown seed. Data now on hand from Porto Rico are insufficient to prove whether or not corn grown in one locality is equally suitable for another locality. Until more information on this point becomes available each planter must decide for himself.

Will it be wise to choose more than one ear of the same type in cases where several ears resemble one another? As a rule, it is better not to do so unless the resemblance is very close, especially in the type characters shown in columns 1 to 6. An ear containing 560 grains for planting will produce 560 plants no two of which will be exactly alike. This fact alone will cause enough difficulty in selecting from the next generation without the introduction of additional differences. If carefully planted and protected from mole crickets, 560 grains should yield practically 560 ears. In case 6 to 7 per cent of these 560 ears are desirable enough to plant, there will be kernels enough for an acre with 4 kernels to the hill, which certainly should be satisfactory to anyone who really desires to improve his crop.

In planting corn is it desirable to select ears from various types? An ear from each of two or more types may be planted advantageously by anyone having the proper facilities. Care must be taken, however, to make the plantings far enough apart to prevent the spread of pollen from one plant to another. Adequate protection in a patch can safely be had by planting some 200 feet from other corn and surrounding it by several rows of pigeon peas.

If the score card has been correctly filled out, it will be possible to interpret it from the total in column 21. Of course, that statement should not be taken too literally. There is no system of seed selection which is not subject to great errors. These, however, can be eliminated to a very large extent by using good judgment.

#### HOW TO INTERPRET SCORE CARD NO. 2.

Only a small percentage of the first crop will be superior, or even equal, to the mother ear. Selection must again be made and those ears likewise judged, everything not conforming to the mother type







### THE EAR-TO-ROW METHOD.

It should always be kept in mind that eternal vigilance is the price of any superior product. Therefore, after having established a variety or a strain, continual selection must be kept up year after year, for it is only in this manner that a variety can be maintained at its highest standard.

The ear-to-row method is a well-known one. By this method a certain number of ears of the same type after having been selected are planted, each ear in a row by itself. The work required for this procedure is hardly more than where the ears are shelled and the grain from all the ears is mixed.

In order that this method may be followed, a level field with average soil of nearly uniform quality must be chosen. The rows should be arranged in the usual manner and a stout stake, indicating the number of the row, should be placed at the end of each row. There should be as many rows as there are ears, the length of the rows being determined by the size of the smallest ear. If the smallest ear contains only 400 kernels for planting, the rows will need to accommodate only 100 hills, or in other words the rows should be 100 meters long, with a meter from hill to hill and 4 kernels should be planted to the hill.<sup>1</sup> Drop an ear by each stake before starting to plant. Shell one ear and plant its kernels before starting to shell the next ear. Whatever kernels are left over from each ear after planting a row may be poured into a bag and the mixed grain used for seed in some other place. Of course the odd-shaped tip and butt kernels should not be planted.

Prepare a field chart, as shown below, and enter thereon all the numbers in column 1 before it is time to harvest the corn. Next, go through the field row by row, counting the number of plants. In column 3 enter the average measurement of the height of a number of representative plants. In column 4 note the average height of the ears, and in column 5, their position. In this particular instance position means whether the ears are placed upright; that is, with the point upward, reclining, or hanging downward. Let U stand for upright, R for reclining, and D for pointing downward. In column 6 note the number of ears per plant. Should the majority of the plants carry one ear only, this in all probability will be the type character. Where more than one ear is carried by the majority, it is most important that note should be made of such result, and likewise, if there are many barren plants.

Pick the ears from each row separately, placing them at the end stake. After removing the husk, separate the ears into two grades,

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<sup>1</sup> A meter apart is the common distance of planting in Porto Rico. Because of the poor soil and the poor cultivation practiced, a meter is too close, and for such a distance the plants should always be thinned to one in a hill.

putting the well-shaped ears and those longer than 7 inches in the first grade and the rest in the second grade. Count each grade and note the result.

*Field chart.*

[illegible]

In interpreting the chart, column 3 will indicate the comparative vigor of the type. The typical height of the ears is seen in column 4. A desirable height is about 4 feet. A tendency of the stalk to bend over or break off will result if the ears are borne very high. Column 5, position of ear is of great importance. An ear hanging downward is very much better protected from the entrance of moisture at the tip than where the ear points upward. The number of ears per plant indicated in column 6 will show the general habit of the type in this respect. This character, like some of the others, is not infallibly inherent, but some types will usually produce two ears per stalk, other types will produce but one, whereas still other types have a habit of producing too many barren stalks. Column 7, when compared with column 2, will show the number of first and second grade ears and determine the yield per plant.

It will be found that some of the rows can be at once discarded. Afterward, the best ears from the best rows may be selected and judged as was formerly done. The aim of course should be to select enough corn for the next year's planting. Aside from that, however, a certain number of the most desirable ears should be reserved each season for the coming season's seed supply for planting in the ear-to-row manner.

## HOW TO KEEP SEED CORN.

Among the great many samples of corn received in this office during the last 18 months, none was in better condition than those which had been dried in the kitchen and subjected to smoke from the charcoal stoves. This is a thoroughly practical method and should be more widely applied, but is now used to only a limited extent. In most places it would not be at all practical to turn the



kitchen into a corn-drying establishment, yet any one can dry and smoke a large number of ears in a homemade contrivance.

For this purpose use two barrels, after knocking the heads out of both; also a box which must be slightly longer and wider than the diameter of the barrels, and from 12 to 18 inches in depth. After removing the cover of the box, cut a hole slightly smaller than the diameter of the barrels in the bottom, then another hole about 12 inches square in one side of the box close to the top. Place the box bottom up on the ground with one of the barrels on top, covering the hole previously made. Put the second barrel on top of the first one and secure the two in an upright position with braces. Now place a charcoal burner in the box, using for fuel charcoal with corn cobs and other such material as will produce considerable smoke without blazing.

Hang in the upper barrel the ears of corn which have been tied in a long string by a series of slip knots and suspended from stout sticks laid across the top. The drying and smoking process should be continued for about a week, care being taken never to let the fire blaze. A temperature of 135° F. is perfectly safe, but 145° may cause some injury. The germ in all the kernels will be killed by a temperature above 160° continued for any length of time.

After the ears have been well dried in this manner, all insect eggs will be killed, the smoky condition acting as a repellant against further infestation. As is indicated below, the ears may then be packed in a tight barrel or box. On the bottom of the barrel place about 2 inches of air-slaked lime, next a layer of ears, filling in the spaces between the ears with lime. When this container has been filled in this manner, finish with a few inches of lime to cover the upper layer of corn. Packed in this way, corn may be kept perfectly safe from one season to another, the lime absorbing surplus moisture and preventing weevils from entering.

#### LITERATURE.

Those especially interested in corn may find much valuable information in any one of the following Farmers' Bulletins:<sup>1</sup>

No. 229. The Production of Good Seed Corn.

No. 298. Food Value of Corn and Corn Products.

No. 400. More Profitable Corn Planting.

No. 409. School Lessons on Corn.

No. 414. Corn Cultivation.

No. 537. How to Grow an Acre of Corn.

For more extensive literature on special subjects connected with corn, consult this station.

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<sup>1</sup> Copies of these bulletins may be obtained free on application to the Division of Publications, United States Department of Agriculture.